

1 **FLOW INJECTION ELECTROCHEMICAL DETECTING DEVICE**

2 **BACKGROUND OF THE INVENTION**

3 **1. Field of the Invention**

4 The present invention relates to an electrochemical detecting device
5 for a fluid, and more particularly to an electrochemical detecting device in
6 which an electrode can be changed quickly and easily.

7 **2. Description of Related Art**

8 An electrochemical detecting device is a burgeoning object in
9 chemical studies and has high scientific value to provide considerable
10 economical benefits, because the electrochemical detecting device is widely
11 applied in various fields of science and technology. A good detecting device
12 needs to have excellent selectivity, sensitivity, and short detecting time and
13 further have excellent stability and reliability. In order to reduce the quantity
14 of testing samples as less as possible in the electrochemical detecting device
15 and also to simplify the operational procedure, the electrochemical detecting
16 device is minimized in size and designed to satisfy these requirements.

17 Additionally, the electrochemical detecting device can be easily combine
18 with various electrodes to the trace analysis in different fields such as bio-
19 chemistry, environmental estimation, drug control, cosmetic control etc. It
20 can also combine with flow injection analysis (FIA), high performance liquid
21 chromatography (HPLC), or capillary electrophoresis (CE) to increase the
22 sensitivity in detection.

23 With reference to Fig. 9, a conventional electrochemical detecting
24 device comprises a base (60), a cover (70), a working electrode (80) and a

1 compartment layer (90).

2 The base (60) has a top (not numbered) and two positioning holes
3 (62) vertically defined through the base (60). The working electrode (80) is
4 mounted on the top of the base (60) and has two through holes (82)
5 respectively aligning with the positioning holes (62) of the base (60). An
6 inner lead (83) and an outer lead (84) electrically connect with each other
7 and are attached on the working electrode (80) between the two through
8 holes (82).

9 The compartment layer (90) is mounted on the working electrode (80)
10 and also has two through holes (92) respectively aligning with the
11 positioning holes (62). A rectangular channel (94) is defined between the two
12 through holes (92) in the compartment layer (90) and accommodates the
13 inner lead (83) inside the rectangular channel (94).

14 The cover (70) is mounted on the compartment layer (90) and has a
15 bottom (not numbered) and two posts (76) extending from the bottom to
16 respectively penetrate through the through holes (92, 82) of the compartment
17 layer (90) and the working electrode (80). Two bolts (762) are respectively
18 attached to the posts (76) to firmly clamp the working electrode (80) and the
19 compartment layer (90) between the cover (70) and the base (60). Whereby,
20 the channel (94) of the compartment layer (90) defines a space (not
21 numbered) for liquid. An inlet (72) and an outlet (74) are defined in the cover
22 (70) to communicate with the space for entry or exit of the liquid.

23 When the electrochemical detecting device operates, the detected
24 liquid is injected into the space via the inlet (72) and the outer lead (84) is

1 electrically connected with a readout system. Whereby, the inner lead (83)
2 enables transmission of chemical data (for example: capacitance) to the
3 readout system via the outer lead (84).

4 However, the conventional electrochemical detecting device still has
5 some drawbacks in operation caused from the structure. For example,
6 changing the working electrode (80) is troublesome since the bolts (762)
7 have to be individually detached from the posts (76) to take the working
8 electrode (80) out when assembling or disassembling the device. More
9 particularly, if the working electrode (80) is disposable in nature, it has to be
10 changed very often. Additionally, the working electrode (80) and the
11 compartment layer (90) both must be punched to define through holes (82,
12 92) to allow the posts (76) to penetrate there through which also causes more
13 trouble in the manufacturing processes.

14 The present invention has arisen to mitigate or obviate the
15 disadvantages of the conventional electrochemical detecting device.

16 **SUMMARY OF THE INVENTION.**

17 The first objective of the present invention is to provide a flow
18 injection electrochemical detecting device, which is easily operated to
19 change working electrodes.

20 The second objective of the present invention is to provide a flow
21 injection electrochemical detecting device, which is enabled to cooperate
22 with various electrodes accessories to work in different systems.

23 Further benefits and advantages of the present invention will become
24 apparent after a careful reading of the detailed description with appropriate

1 reference to the accompanying drawings.

2 **BRIEF DESCRIPTION OF THE DRAWINGS**

3 Fig. 1 is an exploded perspective view of a flow injection
4 electrochemical detecting device in accordance with the present invention;

5 Fig. 2 is a cross-sectional side plane view of the flow injection
6 electrochemical detecting device, wherein the device is closed;

7 Fig. 3 is an operational side plane view of the flow injection
8 electrochemical detecting device in Fig. 2;

9 Fig. 4 is a cross-sectional front plane view of the flow injection
10 electrochemical detecting device in Fig. 2;

11 Fig. 5 is a cross-sectional top plane view of the flow injection
12 electrochemical detecting device showing a first operating embodiment;

13 Fig. 6 is a cross-sectional top plane view of the flow-through
14 electrochemical detecting device showing a second operating embodiment;

15 Fig. 7 is a cross-sectional top plane view of the flow injection
16 electrochemical detecting device showing a third operating embodiment;

17 Fig. 8 is a cross-sectional top plane view of the flow injection
18 electrochemical detecting device showing a fourth operating embodiment;
19 and

20 Fig. 9 is an exploded perspective view a conventional flow injection
21 electrochemical detecting device in accordance with the prior art.

22 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

23 With reference to Figs 1 and 2, a flow injection electrochemical
24 detecting device in accordance with the present invention comprises a body

1 (10), a cover (20) pivotally mounted on the body (10) and a locking device
2 (30) attached between the base (10) and the cover (20).

3 The base (10) is a quadratic prism and has a top (not numbered), four
4 sides (not numbered), a front end (not numbered) and a rear end (not
5 numbered). The base (10) has a recess (12) defined in the top and a pivotal
6 post (11) formed near the rear end. Optionally, multiple anti-slip grooves
7 (102) are defined in the four sides for a user to hold the base (10) easily. The
8 recess (12) preferentially is a dovetail recess so as to avoid a working
9 electrode inside the recess (12) detaching from the top when the working
10 electrode is attached on the cover (20).

11 The cover (20) pivotally attached on the top of the base (10) is also a
12 substantially quadratic prism and has a top, a bottom, a front end, a rear end
13 and two sides. The cover has two side cutouts (not numbered) defined at the
14 front end, a resilient separator (not numbered) with an inner opening (not
15 numbered), and multiple channels defined in the cover to extend to
16 communicate with the inner opening of the resilient separator. Preferentially,
17 as shown in Figs. 1 and 2, an annular trench (28) is defined in the bottom of
18 the cover (20) and an O-ring (282) serves as the resilient separator partially
19 received in the annular trench (28). An inlet (22) is defined through the cover
20 (20) from the top to the bottom at an area within the annular trench (28).
21 Moreover, a first outlet (24) and a second outlet (26) are respectively defined
22 from opposed sides to the bottom of the cover (20) at the area within the O-
23 ring (282). The cover (20) further has a cutout (21) defined at the rear end to
24 receive the pivotal post (11) of the base (10), and a pin (111) penetrates the

1 cover (20) at the cutout (21) and the pivotal post (11) to pivotally combine
2 the cover (20) and the base (10). When the cover (20) is pressed downward
3 to entirely mate with the base (10), the O-ring (282) defines a space (a)
4 between the base (10) and the cover (20).

5 The locking device is attached between the base (10) and the cover
6 (20) to close the detecting device tightly. The locking device is composed of
7 two locating posts (14) each with a retractable ball (186) and erected on the
8 top of the base (10). Two ball dents (23) are defined in peripheries of the side
9 cutouts to respectively align with corresponding balls (186) on the locating
10 posts (14). Preferentially, each locating post (14) has a threaded hole (142)
11 defined in the locating post (14) and has a threaded rod (18) screwing into
12 the threaded hole (142). The threaded rod (18) has a bore (182) defined
13 axially to receive the ball (186) with a resilient element (184). The resilient
14 element (184) provides a restitution force to the ball (186) to push the ball
15 (186) to detachably engage and lock with the ball dent (23). By adjusting a
16 depth of the threaded rod (18) going into the threaded hole (142), the
17 tightness degree of the locking device is adjustable. Preferentially, the
18 resilient element (184) is a spring. When the cover (20) closes on the base
19 (10), the ball (186) engages with the ball dent (23) to lock the cover (20) on
20 the base (10). Meanwhile, the O-ring (282) is clamped between the cover (20)
21 and the base (10) and defines the space (a). When raising the cover (20), the
22 cover (20) is pull upward to force the ball (186) to slightly move backward
23 until separating from the dent (23). Therefore, the cover (20) is easily closed
24 or opened in a convenient way of just moving the cover (20).

With reference to Figs. 1 and 4, the flow injection electrochemical detecting device in the present invention needs other accessories when the device is operated. The accessories comprise a reference electrode (30), an auxiliary electrode (40), and a working electrode (50). The auxiliary electrode (40) and the reference electrode (30) have a first metal shaft (44) and a second metal shaft (34) respectively. The first metal shaft (44) is a hollow tube penetrating the auxiliary electrode (40) until reaching the inlet (22) to exhaust the liquid. The second metal shaft (34) is not hollow and is immovably attached at a rear end of the reference electrode (30) so that the second metal shaft (34) can not exhaust the liquid thereby. The reference electrode (30) and the auxiliary electrode (40) are selectively inserted into the first outlet (24) and the second outlet (26). In order to make combination of the electrodes (30, 40) and the outlet (24, 26) easy, each electrode (30, 40) has a threaded head (32, 42) and each outlet (24, 26) has an inner thread to correspond to the threaded head (32, 42). Whereby, the electrodes (30, 40) are conveniently engaged with the cover (20) by means of screwing.

Additionally, the working electrode (50) with a top face is placed inside the recess (12) and has a part of the working electrode (50) extending out from the recess (12). An inner lead (52) is attached on the top face and accommodated inside the O-ring (282) when the cover (20) is closed. An outer lead (54) is attached on the top face at the extending-out part to adapt to electrically connect with a readout system.

With reference to Figs. 3 and 4, when the flow injection electrochemical device operates, the liquid is transported to an injector (B)

1 by a pump (M) from a storing bottle (A). The injector (B) provides a high
2 pressure to make the liquid enter the space (a) via the inlet (22). Optionally,
3 the liquid can be purified in an anion-exchange column (C) to remove
4 impurity to avoid error when detecting. Lastly, the electrochemical data
5 sensed by the working electrode (50) and the reference electrode (30) or the
6 auxiliary electrode (40) are transmitted to an electrochemical workstation (D)
7 to translate the data into readable information shown on a monitor (E).

8 With reference to Figs. 5 to 8, the flow injection electrochemical
9 detecting device in the present invention has a variety of operational
10 embodiments in combination with the other accessory electrodes.

11 In Fig. 5, when the electrode (50) is a working electrode, the first
12 outlet (24) has to engage with the reference electrode (30) and the second
13 outlet (26) is kept as an opening channel to exhaust liquid.

14 In Fig. 6, when the electrode (50) is a working electrode, the first
15 outlet (24) selectively closes and the second outlet (26) has to engage with
16 the auxiliary electrode (40), wherein the liquid flows out via the hollow first
17 metal tube (44) in the auxiliary electrode (40).

18 In Fig. 7, when the electrode (50) is a working electrode, the first
19 outlet (24) selectively engages with the reference electrode (30) and the
20 second outlet (26) selectively engages with the auxiliary electrode (40) to
21 double check the electrochemical data. Wherein, the liquid flows out via the
22 hollow first metal tube (44) of the auxiliary electrode (40).

23 In Fig. 8, when the electrode is a three-electrode system (50a), no
24 accessory electrodes are needed. The first outlet (24) closes and the second

1 outlet (26) is kept as an opening channel to allow liquid to exhaust out from
2 the device.

3 According to the above description, the flow injection
4 electrochemical detecting device in the present invention is easily operated
5 since the cover (20) pivotally detaches or engages with the base (10).
6 Therefore, the working electrode (50) can be changed in a convenient way
7 instead of disassembling all elements as shown in the conventional
8 electrochemical detecting device.

9 Although the invention has been explained in relation to multiple
10 preferred embodiments, many other possible modifications and variations
11 can be made without departing from the spirit and scope of the invention as
12 hereinafter claimed.